# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

| Applicant's or agent's file reference | **FOR FURTHER ACTION** | see Form PCT/ISA/220 as well as, where applicable, item 5 below. |
|---|---|---|
| P43568.WO.01 | | |
| International application No. | International filing date *(day/month/year)* | (Earliest) Priority Date *(day/month/year)* |
| PCT/GB2009/051347 | 08/10/2009 | 08/10/2008 |
| Applicant | | |
| Pursuit Dynamics plc | | |

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of:

   [X] the international application in the language in which it was filed

   [ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

   b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**

   a. the figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant

   [ ] as selected by this Authority, because the applicant failed to suggest a figure

   [ ] as selected by this Authority, because this figure better characterizes the invention

   b. [ ] none of the figures is to be published with the abstract

# INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2009/051347

A. CLASSIFICATION OF SUBJECT MATTER
INV. B01D17/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B01D F04F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | EP 1 549 856 A (PURSUIT DYNAMICS PLC [GB]) 6 July 2005 (2005-07-06) | 1-7, 9-14,16, 17 |
| Y | abstract; claims 1,2,13,15,16,22,23,34,39,47; figure 1 paragraphs [0002], [0004], [0011], [0012], [0017] - [0026], [0031] - [0036], [0054], [0064] - [0066] | 8,14,15, 18-23 |
| X | US 2007/210186 A1 (FENTON MARCUS B M [GB] ET AL) 13 September 2007 (2007-09-13) abstract; claims 1,2,6,15,18,21,33,41; figure 1 paragraphs [0088], [0090] - [0104], [0172] | 1,5,9-11 |

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 25 February 2010 | 05/03/2010 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Weber, Christian |

Form PCT/ISA/210 (second sheet) (April 2005)

# INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2009/051347

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | WO 2008/062218 A (PURSUIT DYNAMICS PLC [GB]; FENTON MARCUS BRIAN MAYHALL [GB]; DAWSON ST) 29 May 2008 (2008-05-29)<br>abstract; claims 1,8,9,12-14; figures 1,2<br>page 5, line 26 - page 6, line 20<br>page 7, line 7 - line 27 | 1,2,7, 12,13 |
| Y | US 5 738 762 A (OHSOL ERNEST O [US])<br>14 April 1998 (1998-04-14)<br>cited in the application<br>abstract; claims 1,9; figures 1,2<br>column 1, line 46 - column 2, line 7<br>column 2, line 24 - line 64<br>column 4, line 49 - line 60<br>column 5, line 43 - line 54 | 8,14,15, 18-23 |
| A | US 4 487 553 A (NAGATA FUMIO [JP])<br>11 December 1984 (1984-12-11)<br>abstract; claim 1; figures 1,4<br>column 1, line 42 - column 2, line 20 | 1-23 |

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2009/051347

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| EP 1549856 A | 06-07-2005 | AT 364794 T | 15-07-2007 |
| | | AU 2003274315 A1 | 04-05-2004 |
| | | BR 0315204 A | 16-08-2005 |
| | | CA 2501816 A1 | 22-04-2004 |
| | | DE 60314434 T2 | 14-02-2008 |
| | | DK 1549856 T3 | 22-10-2007 |
| | | ES 2287521 T3 | 16-12-2007 |
| | | WO 2004033920 A1 | 22-04-2004 |
| | | JP 2006503227 T | 26-01-2006 |
| US 2007210186 A1 | 13-09-2007 | AU 2005216699 A1 | 09-09-2005 |
| | | CA 2556673 A1 | 09-09-2005 |
| | | EP 1718413 A1 | 08-11-2006 |
| | | WO 2005082546 A1 | 09-09-2005 |
| WO 2008062218 A | 29-05-2008 | EP 2117668 A2 | 18-11-2009 |
| US 5738762 A | 14-04-1998 | NONE | |
| US 4487553 A | 11-12-1984 | NONE | |

# PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

# PCT

## WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
*(day/month/year)* see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

**FOR FURTHER ACTION**
See paragraph 2 below

| International application No. | International filing date *(day/month/year)* | Priority date *(day/month/year)* |
|---|---|---|
| PCT/GB2009/051347 | 08.10.2009 | 08.10.2008 |

International Patent Classification (IPC) or both national classification and IPC
INV. B01D17/04

Applicant
Pursuit Dynamics plc

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:

European Patent Office
P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk - Pays Bas
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Date of completion of this opinion
see form PCT/ISA/210

Authorized Officer
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# WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/GB2009/051347

## Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

   ☐ on paper

   ☐ in electronic form

   b. (time)

   ☐ in the international application as filed

   ☐ together with the international application in electronic form

   ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

## Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 4,8,14-23 |
| | No: | Claims | 1-3,5-7,9-13 |
| Inventive step (IS) | Yes: | Claims | |
| | No: | Claims | 1-23 |
| Industrial applicability (IA) | Yes: | Claims | 1-23 |
| | No: | Claims | |

2. Citations and explanations

**see separate sheet**

**Re Item V.**

1.Reference is made to the following documents:

D1 : EP 1 549 856 A (PURSUIT DYNAMICS PLC [GB]) 6 July 2005 (2005-07-06)

D2 : US 2007/210186 A1 (FENTON MARCUS B M [GB] ET AL) 13 September 2007 (2007-09-13)

D3 : WO 2008/062218 A (PURSUIT DYNAMICS PLC [GB]; FENTON MARCUS BRIAN MAYHALL [GB]; DAWSON ST) 29 May 2008 (2008-05-29)

D4: US-A-5 738 762 (OHSOL ERNEST O [US]) 14 April 1998 (1998-04-14) cited in the application

2.INDEPENDENT CLAIMS 1,14

2.1The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 is not new in the sense of Article 33(2) PCT.

Firstly, the specification in claim 1 that said apparatus is used for demulsification instead of other usages does not relate to apparatus features and is therefore not a feature that could just on that basis result in novelty of the claim. Additionally the way of operating the device as well as the mechanism of the process in the application are the similar as in D1-D3.
Hence, the application seems to be merely directed to a particular use.
All three documents D1-D3 from the same applicant anticipate the apparatus of claim 1.

Document D1 discloses (figure 1, claim 1 and par.64-66):
A fluid mover or jet pump (1) suitable for emulsification but also disintegration (par.2) and hence also demulsification, comprising a housing (2) defining;
-a fluid processor including a passage (3) having an inlet (4) and an outlet (5), and a transport fluid nozzle (16) circumscribing the passage and the opening into the passage intermediate the inlet (4) and outlet (5); and
-a transport fluid source (10) in fluid communication with the transport fluid nozzle (16);
-wherein the cross sectional area of the passage (3) between the inlet (4) and the outlet (5) does not reduce below the cross sectional area at the inlet (4) (see par. 64 for constant circular cross section of the passage); and
-wherein the transport fluid nozzle is a convergent-divergent nozzle having a nozzle inlet (exit from plenum 8), a nozzle throat (16), and a nozzle outlet (expansion into

mixing chamber (3A), and the cross sectional area of the nozzle throat is less than that of either the nozzle inlet or the nozzle outlet (the nozzle (16) is of convergent-divergent geometry as defined in claim 1).

D2 (figure 1, claim 1 and 2, par.88-102) discloses a similar apparatus to D1 more intended to generate a mist (abstract) by the same working principle as in the application. The venturi shape of the annular transport nozzle (16) is defined in more detail (angle $\alpha$ in par.102).

D3 (figure 2, claim 8, page 7 line 7- page 8 line 5) discloses a similar apparatus to D1 more intended to remove volatile elements from process fluids by however also the same mechanism as in the application.

Hence, claim 1 is not novel (Article 33(2) PCT).

2.2.The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 14 does not involve an inventive step in the sense of Article 33(3) PCT.

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and discloses (figure 1, claim 1,):

A method of moving a feed liquid (claims 22,34) through a jet pump as disclosed in D1 (see above), the methods comprising the steps of:
-supplying said feed to a fluid processor passage having an inlet and an outlet;
-supplying a transport fluid through the annular nozzle;
-accelerating the transport fluid in the venturi shaped nozzle;
-atomising said feed and creating a vapour-droplet regime;
-vaporising at least some of the droplets;
-condensing said vapour (claim 23).

The subject-matter of claim 14 therefore differs from this known D1 in that:
The feed is an emulsion in claim 14 whereas in D1 no emulsion as a feed to the jet pump is disclosed.

The technical effect achieved by feeding an emulsion to said jet pump is that

demulsification of an emulsion occurs.

The problem to be solved by the present invention may therefore be regarded as how to demulsify an emulsion by means of a jet pump.

The solution proposed in claim 14 of the present application cannot be considered as involving an inventive step (Article 33(3) PCT) for the following reasons.
The mechanism of demulsification is detailed in the application on page 15 line 13 to page 16 line 25 and is in short described as follows;
Injection of a transport fluid via the nozzle imparts shearing forces that atomise the emulsion so as form a vapour-droplet regime. Differences in pressure, temperature and velocity lead to increased likelihood of droplet collisions followed by condensation and shockwaves.
The use of the jet pump of D1 for providing a mist followed by wetting is based on the same principles; namely imparting shearing forces that atomise the feed (e.g. emulsion) so as form a vapour-droplet regime followed by condensation and shockwaves (par.54). Said jet pump can thus also be used for demulsification as is also hinted by the term disintegration (of a dispersed phase in a continuous phase).

Hence, claim 14 lacks an inventive step (Article 33(3) PCT).

It is additionally remarked that demulsification of an emulsion is achieved by means of flowing an emulsion through a Venturi nozzle (20) in figure 2 in D4 (claim 1). Condensed recycled water (19) is heated to create steam and can be injected down stream of heater 14 into the emulsion feed (column 4 line 49-60) so as to create the flashing of the emulsion through said Venturi nozzle (20). Though the shape of said nozzle 20 is not further specified, the mechanism through which demulsification is achieved is essentially similar as in claim 14; namely flashing of the emulsion with aid of an injected fluid (steam) followed by condensation by means of a variation in pressure caused by the Venturi-nozzle. It would hence be obvious to a person skilled in the art to apply the known jet pump from D1 to the demulsification system of D4.

3.Dependent claims 2-13 and 15-23 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

Novelty

-Claim 2: D3 (figure 1) shows a holding vessel (10) in fluid communication with steam injector (30).
-Claim 3: D1 (claim 2) mentions a steam inlet (10) which means that the steam is supplied from a steam source (generator).
-Claim 5: D2 (figure 1) shows an additional port (30) located just downstream of the transport fluid nozzle outlet (16).
-Claim 6: D1 (par.26) discloses a series of nozzles with their respective mixing chambers (fluid processors).
-Claim 7: D3 (figure 1) shows a container (48) in fluid communication with the outlet of steam injector (30).
-Claim 9: D2 (par.102 and figure 1) indicate a nozzle throat with an angle of expansion up to 12 degrees for sub-sonic flow.
-Claim 10,11: D2 (par.102 and figure 1) indicate an angular orientation of the transport nozzle up to 30 degrees relative to the boundary flow which includes the range given in claim 11.
-Claim 12: D3 (figure 1, claim 14 and page 5 line 28) discloses a recirculation loop (12).
-Claim 13: D3 (figure 1): Check valves for pressure control are located within loop (12) upstream (22) and downstream (50) of steam injector (30).

Inventive step:

-Claim 4: Pressure controllers for steam supply in general are very common in the art.
-Claim 8: Centrifuges are commonly used for the same purpose as claimed, namely separation of two none mixing liquids (e.g. D4 figure 1/2).
-Claim 15: D4 sows a an overhead separator (50) for separating condensed constituents of a flashed emulsion for the same purpose as in the invention.
-Claim 16,17: D1 (par.31) specifies the introduction of air or steam as a transport fluid in order enhance evaporation of the emulsion.
-Claim 18,19,23: D4 (claim 1) discloses the demulsification for an (crude) oil-water emulsion by means of introduction of steam (=compressed gas) upstream the injector.
-Claim 20: D4 (column 5 line 43-53) discloses the addition of chemical additives to facilitate demulsification. It is an obvious possibility to add such chemicals via an additional port in the device itself.
-Claim 21,22: As an obvious alternative the additive in claim 20 can also be a diluent.

that can be introduced into the emulsion before the jet pump or via an additional port in the device itself.